Report of the Director and Board of Governors

Introduction

During the time covered by this report, April 1, 1983 to March 31, 1984 some significant changes occurred at the Centre. Mr. Harold Snyder, the Founding Director of C-CORE, resigned in the fall. Since 1975, Mr. Snyder had taken an active role in the development of the Centre's research programs and he had worked energetically to strengthen C-CORE's collaboration with industry and government. Mr. William Winsor, C-CORE's Assistant Director, assumed the position of Acting Director for the period of transition until the appointment of the new Director, Dr. J. I. (Jack) Clark, in the spring. An announcement of Dr. Clark's appointment was printed in C-CORE News Vol. 9, No. 2.

The Centre was visited by numerous groups and individuals from industries, governments and universities who were interested in our research programs. Many of these visitors were representatives of C-CORE's Associates; others expressed interest in becoming new Associates. C-CORE was invited by the Canadian Standards Association (CSA) to participate in the task of developing Canadian Standards for Frontier and Offshore Structures. This project, which is under the auspices of CSA, is supported by the Canada Oil and Gas Lands Administration (COGLA) and the Canadian Petroleum Association. The project was described in the July 1984 issue of C-CORE News.

Several C-CORE researchers presented papers at workshops and conferences. These were included in the 1983 and 1984 Publication Series. Fifteen papers of the 1983 list and twelve of the 1984 list are now available.

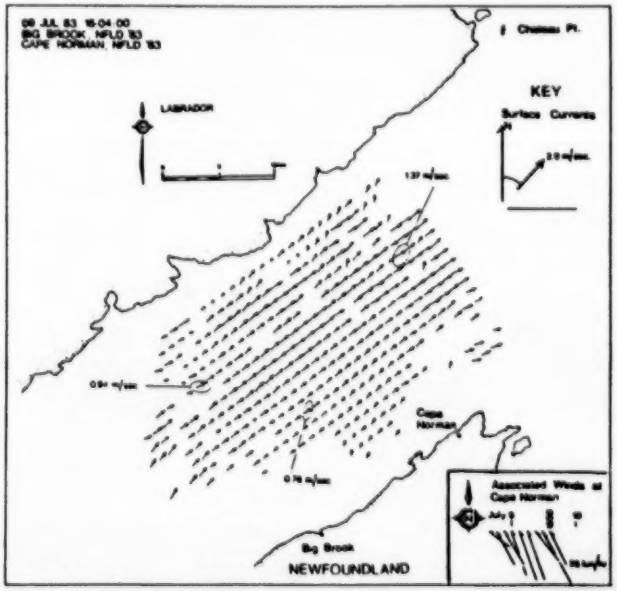
C-CORE awarded fellowships to two graduate students of the Faculty of Engineering and Applied Science. Now that their programs are nearing completion, one student has joined the Institute of Marine Dynamics (IMD) and the other will come to C-CORE.

The Research Programs 1983-84

The three areas of research are Radar and Remote Sensing, Seabed and Ice Properties.

Radar and Remote Sensing Program

The Centre undertook a joint ice/ocean radar experiment in the Strait of Belle Isle. The Faculty of Engineering and Applied Science and C-CORE were awarded a three year NSERC strategic grant, starting in 1983, to study HF radar as a method of detecting and tracking icebergs and ice features. The first fieldwork to collect data on radar cross-sections of icebergs was planned for a test range at the eastern approaches to the Strait of Belle Isle. This site was chosen because previous experience indicated that it was an ideal area for sighting icebergs driven by the strong current. This year, however, very few bergs were sighted. The second portion of the work was a contract for Atlantic Oceanographic Laboratory (AOL) for a 5 day CODAR surface current measurement of the entrance to the Strait. The net outflow from the Gulf of St. Lawrence observed on these surface current maps helped to explain why there were no icebergs entering the radar detection range even though the occurrence of icebergs elsewhere was high this year. The theoretical and analytical component of the NSERC ice detection work was more fruitful. Dr. J. Walsh of the Engineering Faculty completed his formulation of the radar cross-section of ice features; subsequent calculations indicate that there is a high probability of detecting ice features. In addition, the model work suggests that both better range and more stable radar cross-sections can be expected at lower frequencies.



Typical CODAR surface current map for the Strait of Belle Isle.

The CODAR experiment was followed by a data analysis contract for AOL to analyse the collected data. The main objective is to validate CODAR's performance by comparing its results with those of existing current measurement instruments and thus establish the accuracy of the radar measurements. The strength of the CODAR system is its ability to observe surface current patterns over an extended area; the area covered in the Strait of Belle Isle was 350 km^2.

The Radar Group also undertook a small contract for the Canadian Hydrographic Service (CHS) to investigate the feasibility of using CODAR to survey the surface currents over lower salinity estuarine and arctic waters. CHS is interested in the charting of currents in confined waterways. The conclusion was that CODAR could be used but the applications would need to be rationalized against the 1.2 km resolution of the radar range gates.

In November 1983, the Centre hosted an International Workshop on Remote Sensing of Oceanic Variables Using HF Groundwave Radar under the sponsorship of the Department of Fisheries and Oceans and the National Research Council. The Workshop was well attended. The 40 participants included researchers from five countries and technical people from a number of petroleum companies, ocean service companies and government agencies. The presentations, discussions and personal contacts have already been invaluable for our own HF remote sensing program.

The program for the next year will continue the field measurement of radar cross-sections of ice features, do further oceanographic work with AOL, move toward statistical interpretation of surface currents and develop methods for wave spectra processing.

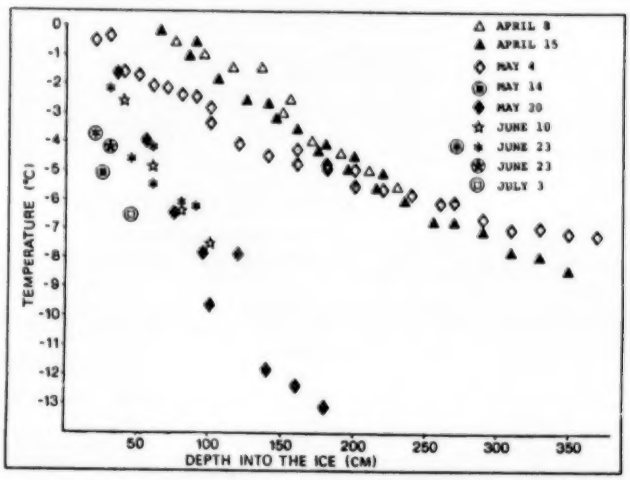
Ice Properties Program

The Ice Properties Group continued with field testing of the instrumented ice auger in the rubble field of Tarsiut Island, Gulf Canada Resources Ltd.'s artificial island in the Beaufort Sea (with logistic support from Gulf Canada Resources Ltd.) and on spring ice conditions in Lake Melville. This equipment has proven itself to be a useful tool for measuring the relative ice "hardness" of various ice formations.

Lake Melville - Joy Harmon of C-CORE (left) installing a thermistor probe and Terry Hann of Acres Consulting Services Ltd. (centre) taking core samples.

A new apparatus for determining fracture toughness values of full scale ice blocks was designed and tested. With continued logistic support from Esso Resources Canada Limited, two field trips were conducted during the 1983-84 season to Pullen Island in the Mackenzie Delta region of the Beaufort Sea. The results were encouraging and we hope to continue this research in the ice tank of the new Institute of Marine Dynamics (IMD).

Work at Pond Inlet and Adams Island, N.W.T., has continued through the 1984 field season, with emphasis placed on documenting structural changes which occur in sea ice as a result of its interaction with grounded structures. Work is also progressing on the development of a sea ice classification scheme and the modelling of sea ice structures in the laboratory. Support has been obtained from the National Research Council. A field investigation was undertaken to test the hypothesis that the near-surface temperature of icebergs in warm sea-water will be colder than that of bergs in colder northern waters. Icebergs in the vicinity of St. John's were visited between April and July; temperature profiles were taken to a maximum depth of 3 m. The inherent instability of the bergs late in the season prevented boarding. Readings obtained in June and July were from depths less than a metre and, for the most part, were taken from recently calved growlers and areas of the iceberg which could be approached safely by boat. A synoptic presentation of these measurements is shown in the figure, and strongly supports the theory outlined above. The significance of these findings is that the near surface ice of bergs in the relatively warm waters of the Grand Banks will be colder and therefore stronger than previously thought. In the event of a collision, this cold glacial ice, including the smaller masses such as growlers and bergy bits, could inflict greater damage than expected.



Related work being carried out in conjunction with the Faculty of Engineering and Applied Science is concerned with the motion of glacial ice masses in typical sea states. Wave tank model tests suggest that relatively small ice masses, about 100,000 tonnes, may achieve instantaneous velocities up to 5 times greater than their average drift speed. This could result in impact energies that may dominate the design criteria. Field work is underway to investigate these findings further.

Pullen Island: Prepared ice sample for fracture toughness experiment

The third iceberg research project undertaken by C-CORE in the past year concerns fragmentation. A survey of past attempts was made and a field project is planned to test a modification of one of the most promising methods reported.

Seabed Program

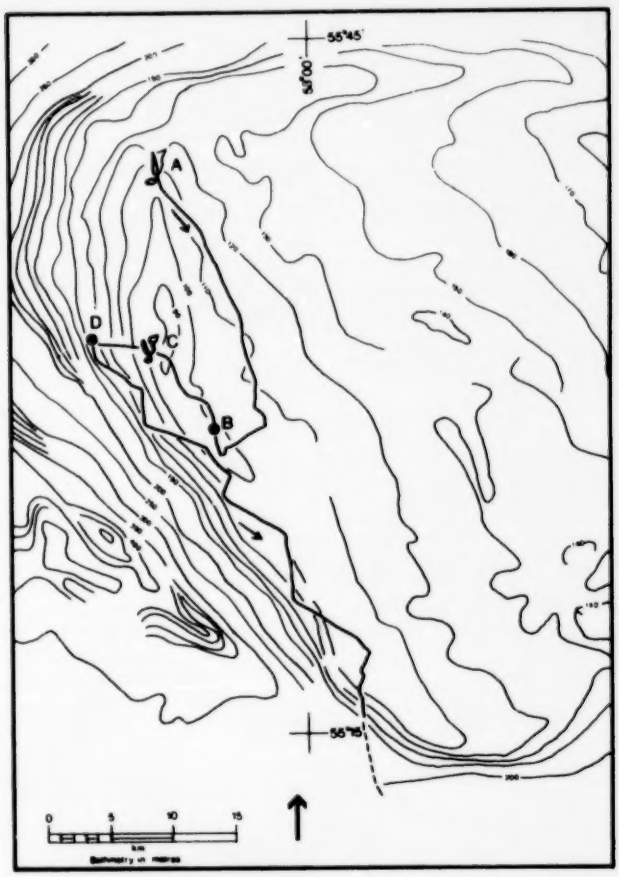
An OERD contract was awarded through DSS to undertake research on the Holocene Development and Sediment Stability of the Northeastern Grand Banks of Newfoundland. Geophysical and camera sled transect data were collected in October of 1983 from the *CSS HUDSON* for this project. This survey combined the vibrocore data collected in July by Dr. C. F. M. Lewis of the Geological Survey of Canada and the borehole data collected from the *MV PHOLAS* by C-CORE during the Mobil Hibernia Borehole Project in September and October.

Studies of Benthic community composition and boring environments, as they relate to seabed stability, were carried out by the Newfoundland Institute of Cold Ocean Science (NICOS). Using a laboratory wave tank, the Faculty of Engineering has nearly completed a study of cyclic loading and liquefaction of Hibernia sands, leading to sediment transport. These projects form part of the larger Hibernia Sediments Program.

The first phase of a research project begun last year to delineate the frequency of iceberg grounding and scouring on the Labrador Shelf has been completed. Up to eight years of radar tracks of icebergs have been analysed from twenty-two wellsites. Scouring/grounding frequencies were found to vary between 3.3% and 5.1% in the two most thoroughly covered areas on Makkovik and Saglek Banks respectively. Work is continuing on the second phase. In order to refine the criteria for identifying scouring bergs, accelerations and velocities in those portions of the tracks where the bergs were scouring, will be examined.

The study of the Quaternary history of Hopedale Saddle, Labrador Shelf, has expanded with the analysis of deep seismic reflection records. It is expected that a geological type-section for the Labrador Shelf can be defined from this work.

The second and final phase of the iceberg scouring study, undertaken in the region of the Davis Strait where Canterra Energy Ltd. drilled the Hekja and Ralegh wells in 1982, has been completed. A supplementary sediment and stratigraphic study of additional cores collected during 1982 has been initiated with support from Memorial University and the Bedford Institute of Oceanography (BIO), and is nearing completion; a final report is due early in 1985. In addition, micro-stratigraphic studies were completed under contract from NORDCO Ltd. and BIO for cores collected along proposed pipeline routes from the Hibernia discovery area to the Avalon Peninsula. The aim of these studies was to establish a time frame for the upper subsurface sedimentary layers on the Grand Banks of Newfoundland.



Track of an iceberg on the western edge of Makkovik Bank, Labrador. Berg scours from A. to B. where it grounds at about 98 m then moves downslope, still scouring, to point D. where it grounds again at 135 m. The zig-zag motion of the remaining scour track is probably the result of rotary currents caused by semi-diurnal tides or inertial currents. The berg finally becomes free-floating (dashed line) at about 55°15'N. The "confused" motion at A. and C. appears characteristic of some scouring bergs.

During the same period, equipment was constructed at C-CORE to facilitate the grain-size analysis of sediment; it is presently operational. The system, known as the Sedimentation Tower, facilitates the quick and accurate analysis of sand sized sediment. It is anticipated that the larger scientific and industrial community of St. John's will be given access to this system. A user manual for the system is presently being completed.

In preparation for a detailed deep-sea seabed and geotechnical study of the Flemish Pass and the northwestern Labrador Sea area, to be undertaken this September, using SEAMARC (Sea Mapping and Remote Characterization) equipment, C-CORE participated in a BIO research survey in June 1983 using the same equipment in the Laurentian Fan area, between Nova Scotia and Newfoundland. The proposed research program has been keenly supported by Canterra Energy Ltd., and Shell Canada Resources Ltd., with active participation by Esso Canada Resources Ltd. and the Bedford Institute of Oceanography, Dartmouth, Nova Scotia.

Physiographic relief map of the eastern Canadian continental shelf and slope.

Ocean Engineering Information Centre (OEIC)

The OEIC continued with its objective to make cold ocean engineering information readily available to the scientific and engineering community. This was achieved by transferring bibliographic data relating to the cold ocean environment into an international computer database system. Funding for the project was obtained through the Office of Energy Research and Development (Energy, Mines and Resources Canada), to transfer the information from OEIC into the Canadian database ASTIS, (Arctic Sciences and Technology Information System). The project culminated in a joint publication of C-CORE and the Arctic Institute of North America (the manager of ASTIS) listing documents on cold ocean engineering (No. 84-12). Since the information available at the Centre has been listed on ASTIS, requests for documents directed to OEIC have increased.

OEIC also provided services to the Royal Commission on the Ocean Ranger Marine Disaster and undertook work on behalf of the Canada Institute for Scientific and Technical Information. The Centre continued to help the Institute of Marine Dynamics to plan its library services.

The OEIC hosted an international conference relating to northern libraries and information centres, in St. John's in August of 1984. Delegates from North America, Scandinavia and Europe attended the conference. The Proceedings will be published later this year (No. 84-19).

Members of other research groups joined several C-CORE field trips. Photos above and on page 14 show three of these.
Above: King William Island (L-R) Chris Woodworth-Lynas of C-CORE, Dr. Terry Day of Day and Associates, Halifax, and Margaret Seidel of Petro-Canada (see article page 2).

Financial

C-CORE's operating account position for 1983/84 has been prepared on an accrual basis. The C-CORE Research Trust which stood at $938,913 at the beginning of the year under review, received contributions of $848,250 and interest income of $93,281 for the year. The drawdown of funds from the Research Trust to the operating account of $792,744 was authorized to cover the operating expenditures. A further $553,666 was received from project funding, contracts and other sources for the research programs and credited to the operating account. This resulted in a total revenue for the year of $1,346,410. Expenditures for the year were $1,307,572.

In addition to financial contributions, contract revenue and other money, C-CORE received support-in-kind estimated to be $358,800 in the form of field services and logistic support from government agencies and industries. Accommodation, laboratory facilities and administrative support services were provided by Memorial University.

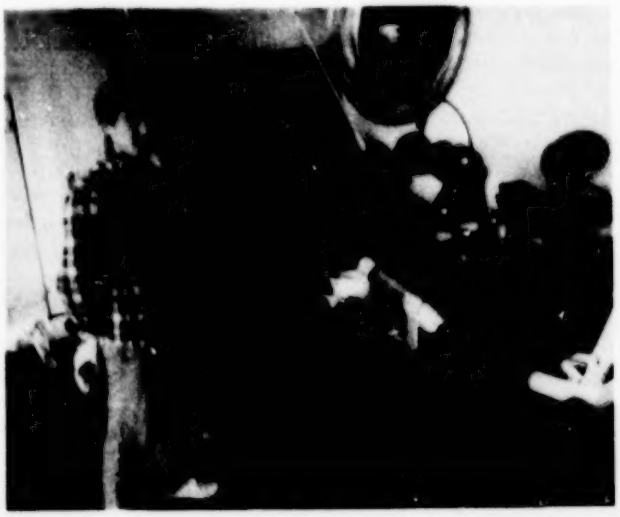
For the 1984/85 fiscal year, the Centre has budgeted capital and operating expenditures and income from all sources of $1,625,000.

Associates

The Centre has continued to work closely with the Associates in planning the research programs. The Seventh Annual Associates' Workshop was held at the Centre in St. John's in the fall; 35 representatives of the Associates attended. The Centre appreciated the Associates' contributions and their recommendations to the research staff. Discussions during the Workshop resulted in cooperative research programs which were undertaken during the following winter months.

In 1983-84, commitments from the Associates to the Research Trust continued to be realized. Logistic support was also provided by the petroleum industry and the Bedford Institute of Oceanography in support of the research programs in the Arctic and on the east coast offshore.

"Terra Nova" Icebound in the Pack — one of a series of prints by H. G. Ponting of the British Antarctic Expedition 1910-1913, part of the Victor Campbell Collection at C-CORE. Contact C.M.T. Woodworth-Lynas at C-CORE for information.



Bill Collins, of C-CORE (L), and Lt. Tom Tulloch of the Canadian Forces, the navigation officer of the *HMCS CORMORANT*, during the submersible operations on the Grand Banks (see page 8).

Dr. Malcolm Mellor, of CRREL, joined C-CORE staff on a field trip in Labrador which included some investigations of iceberg fragmentation techniques.

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"Ramparts of Mount Erebus" print by H. G. Ponting (for details see page 13).

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† Committee member only

The Board of Governors met in the fall of 1983 and the spring of 1984. Mr. William Winsor, Acting Director of C-CORE, represented the Centre at the fall meeting held in St. John's. Dr. Jack Clark, the new Director of C-CORE, joined the Board of Governors for the spring meeting held at the Bedford Institute of Oceanography. Special guests from industry and both the federal and provincial government attended and participated in the meetings. A number of current issues facing the Centre were discussed, research directions were indicated and future goals of the Centre outlined.

A. A. Bruneau
Chairman

J. I. Clark
Director